


<b>LLNL Environmental Restoration Division (ERD)</b> <b>Standard Operating Procedure (SOP)</b>							
<b>ERD SOP 1.3: Drilling—Revision: 4</b>							
	<div style="text-align: right; padding-right: 20px;"> <b>AUTHOR(S):</b>  <b>J. Valett*</b> </div> <hr/> <b>APPROVALS:</b> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%; padding: 5px;"> <u>Albert L Lamanie</u>  <b>Division Leader</b> </td> <td style="width: 30%; text-align: right; padding: 5px;"> <u>10/27/00</u> </td> </tr> <tr> <td style="padding: 5px;"> <u>Albert L Lamanie, for Fred Hoffman</u>  <b>Hydrogeology Group Leader</b> </td> <td style="text-align: right; padding: 5px;"> <u>10/27/00</u> </td> </tr> </table> <hr/> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%; padding: 5px;"> <b>CONCURRENCE:</b>  <u>Kelvin D. Bly</u>  <b>QA Implementation Coordinator</b> </td> <td style="width: 30%; text-align: right; padding: 5px;"> <b>Date</b>  <u>10/23/00</u> </td> </tr> </table>	<u>Albert L Lamanie</u> <b>Division Leader</b>	<u>10/27/00</u>	<u>Albert L Lamanie, for Fred Hoffman</u> <b>Hydrogeology Group Leader</b>	<u>10/27/00</u>	<b>CONCURRENCE:</b> <u>Kelvin D. Bly</u> <b>QA Implementation Coordinator</b>	<b>Date</b> <u>10/23/00</u>
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## 1.0 PURPOSE

The purpose of this SOP is to ensure acceptable, consistent drilling procedures for ground water investigations that include borehole logging and sampling and monitor well, extraction well, or piezometer installation.

## 2.0 APPLICABILITY

This procedure is applicable for all personnel performing drilling operations and shall be fully reviewed prior to conducting these activities.

## 3.0 REFERENCES

- 3.1 Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske (1985), *Practical Guide to Ground Water Sampling*, U.S. Government Printing Office, EPA/600 2-85/104.
- 3.2 Department of Water Resources (1981), *Water Well Standards: State of California*, California Resources Agency, Bulletin 74-81.

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- 3.3 Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response (29 CFR 1910.120).

## **4.0 DEFINITIONS**

See SOP Glossary.

## **5.0 RESPONSIBILITIES**

### **5.1 Division Leader**

The Division Leader's responsibility is to ensure that all activities performed by ERD at the Livermore Site and Site 300 are performed safely and comply with all pertinent regulations and procedures, and provide the necessary equipment and resources to accomplish the tasks described in this procedure.

### **5.2 Hydrogeology Group Leader (HGL)**

The HGL's responsibility is to ensure that proper procedures are followed for activities (i.e., drilling, borehole logging and sampling, monitor well installations and development).

### **5.3 Drilling Supervisor (DS)**

The DS schedules overall drilling related activities and coordinates the drilling contractor schedules and equipment needs.

### **5.4 Drilling Coordinator (DC)**

The DC provides the interface between the DS, Subproject Leader (SL), Hydrogeologist (HG), and the field personnel. The DC is responsible for notifying Building Coordinators, Site Planning, and LLNL Gardeners, and coordinating any necessary surveys (utilities, biological, archaeological) prior to drilling, and monitoring the progress of drilling activities daily.

### **5.5 Drilling Geologist (DG)**

The DG is responsible for conducting and documenting drilling, operational and safety procedures per the work plan, and to inform the DC and SL of any nonconformances.

### **5.6 Subproject Leader (SL)**

The SL is responsible for the overall investigation, planning, assessment, and remediation within a study area.

### **5.7 Hydrogeologist (HG)**

The HG is responsible for assisting the SL with determining drilling locations.

## **6.0 PROCEDURES**

The drilling process should minimally alter the medium that is being investigated. It is essential that the drilling process not introduce hazardous or foreign substances into the borehole or create

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conduits that facilitate the spread of existing contaminants. Various methods are used for drilling including hollow-stem augers, mud rotary, air or air-mist rotary. In areas of multiple water-bearing zones at Site 300, conductor casings or intermediate casings may be used to isolate each encountered water-bearing zone.

## **6.1 Preparation**

- 6.1.1 Prepare the Drilling Work Plan and Sampling Plan. The DG, SL, and/or HG should review existing geologic and hydrogeologic information to determine drilling locations and estimate key parameters (e.g., sample target zones, depth and thickness, types and concentrations of contaminants, etc.). The DG should fill out a Drilling Work Plan Summary Sheet and a Sample Plan Summary Sheet (SOP 1.2, "Borehole Sampling of Unconsolidated Sediments and Rock," Attachment E) and get the SL's signature. The Drilling Work Plan should include scope of work and purposes of borings/wells.
- 6.1.2 Review the Drilling Work Plan and Sampling Plan. The plans should be reviewed by the DG, TL, a member of the Data Management Team, and a QC Chemist. Inform the appropriate Environmental Analyst of pending drilling activities when appropriate.
- 6.1.3 Perform the applicable preparation activities described in SOP 4.1, "Instructions for Field Personnel."
- 6.1.4 The DG should obtain materials listed in the Equipment Checklist (Attachment B) and obtain the appropriate PPE (SOP 4.1).
- 6.1.5 The DC should verify that underground utilities have been surveyed and that drilling activities will not interfere.
- 6.1.6 The DC should ensure the working areas are cleared of all brush and minor obstructions, as necessary.
- 6.1.7 Decontaminate all downhole drilling and sampling equipment, including the back of the drilling rig (SOP 4.5, "General Equipment Decontamination").
- 6.1.8 Check the source(s) of water to be introduced into the borehole. Request analysis (if none exist) prior to field operations. The criteria used to determine if water is acceptable are previous laboratory analyses demonstrating the water is free of contaminants of concern. The source(s) of introduced water (previously analyzed) shall be recorded on the boring log. If analysis is required, the source and the sum of the reported concentrations of chloroform, bromodichloromethane, chlorodibromomethane, and bromoform in the water quality analysis shall be recorded as the Source Water Trihalomethane Concentration and shall be documented in Attachment A and on the boring log. The supply water should be screened using an FID or PID of trihalomethanes. This field reading shall be known as the Source Water Background Value and shall also be recorded on the field log.
- 6.1.9 Ensure that no solvents, light hydrocarbon-based lubricants, or paints are present or applied to downhole drilling tools or samplers. The lubricants "King Stuff" and "Green Plus" are acceptable for drill rod threads. The Material Safety Data Sheets for the lubricants should be available. Use pure bentonite containing no

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polymers or chemical additives of any kind. Record the brand name and manufacturer of the bentonite used on the Borehole Construction Log (SOP 1.2, Attachment A).

- 6.1.10 Ensure that the back of the drilling rig is free of any mud, leaking hydraulic lines, and excess grease that could be dislodged during drilling. If a leak occurs during drilling, place a drip pan or absorbent pad under the leak and terminate drilling activities until the leak is repaired. If air-rotary drilling is to be used, ensure that air systems include an in-line filter to remove all oil from the compressed air.
- 6.1.11 Prepare Controlled Area per reference 3.3 and conduct safety meeting. The DG should regulate access to the Controlled Area, obtain appropriate signs, and enforce PPE requirements. Document daily safety meetings including topic, attendees, and time on Attachment A.

## **6.2 Operation**

- 6.2.1 Use the Borehole/Well Construction Log (SOP 1.2, Attachment A) to document field information and comments. Complete all lines on the forms. Use the letter designation "NA" (not applicable) or "NK" (not known) in all blank spaces. If some steps or procedures are not performed as described, state the reason on the Borehole/Well Construction Log. The instructions for this form are included in SOP 1.1, "Field Borehole Logging." Also complete a chronology of daily events on the Daily Field Report (Attachment A).
- 6.2.2 Borehole logging must conform to SOP 1.1 procedures. Borehole sampling for subsequent chemical/radiological analysis must conform to SOP 1.2.
- 6.2.3 Screen samples of the drilling mud using the PID or FID prior to entering lower hydrogeologic units to prevent possible cross-contamination between shallow and deeper zones. Prevent possible cross-contamination between shallow and deeper permeable water bearing zones by having the driller change-out the drilling mud before drilling through any aquitard.
- 6.2.4 Monitor the work environment per SOP 4.1 during all phases of the work.
- 6.2.5 Collect all soil/rock samples as specified in the Sampling Plan per SOP 1.2. Collect and store all cored sediments or rock according to SOP 1.15, "Well Site Core Handling."
- 6.2.6 If water is encountered in the borehole in which mud was not used, a bailed sample may be requested to gain information about potential contaminants. Samples should be named according to SOP 4.2, "Sample Control and Documentation." Record sampling information including the sample depth on the Borehole/Well Constructions Log. Follow other appropriate SOPs such as SOP 2.4, "Sampling Monitoring Wells with a Bailer" and SOP 4.3, "Sample Containers and Preservation."

Note: If the borehole is left unattended at any time, the DG should ensure that the borehole is covered and protected.

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### **6.3 Post Operation**

- 6.5.1 Perform post-work activities described in SOP 4.1, Section 6.3.
- 6.5.2 The DC should ensure that a daily driller's report is maintained and submitted by the drilling contractor. The report should give a complete description of the number of feet drilled, number of hours on the job, shutdown due to breakdown, length of casing set, materials used, and other pertinent data.
- 6.5.3 Handle all soil cuttings and waste materials per SOP 1.8, "Disposal of Investigation-Derived Wastes (Drill Cuttings, Core Samples, and Drilling Mud)."
- 6.5.4 If temporary casing is needed (for reasons such as lost circulation or excessive caving), decontaminate the casing as outlined in SOP 4.5. The use of temporary casing is well-specific, and its use should be decided upon by the DG, SL, and HG.
- 6.5.5 The abandonment of any boring or well should be in accordance with appropriate state regulations and follow the procedures in SOP 1.7, "Well Closures."
- 6.5.6 The DG should deliver original copies of the Borehole/Well Construction Log, Well Development Form, and other relevant forms and information to the quality control reviewer for review. After review, edit documents and copy and distribute files.

## **7.0 QUALITY ASSURANCE RECORDS**

- 7.1 Borehole/Well Construction Log
- 7.2 Chain-of-Custody Form
- 7.3 Field Logbook
- 7.4 Daily Field Report

## **8.0 ATTACHMENTS**

Attachment A—Daily Field Report

Attachment B—Drilling Geologist Equipment Checklist

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# **Attachment A**

## **Daily Field Report**

## DAILY FIELD REPORT

Date	Project(s):
Name:	Project Manager:
Vehicle:	Job Number:

PID/OVA Calibration: Yes _____ No _____	Daily Site Safety Meeting Time _____
Time: _____	

[illegible]

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## **Attachment B**

### **Drilling Geologist Equipment Checklist**



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## Drilling Geologist Equipment Checklist

- \_\_\_ 300-ft weighted tape
- \_\_\_ Any applicable permits (i.e., excavation, utility clearance, burn permits)
- \_\_\_ Applicable documents (i.e., SSP, OSPs, SOPs, work plan, sample plan, etc.)
- \_\_\_ Appropriate clothing (i.e., coveralls, steel-toed safety shoes, gloves)
- \_\_\_ Barricades/traffic cones
- \_\_\_ Buckets and brushes
- \_\_\_ Caution tape
- \_\_\_ Company ID sign for vehicle
- \_\_\_ Cooler with ice
- \_\_\_ Core boxes, marking pens
- \_\_\_ Deionized water
- \_\_\_ Detergents (Alconox, Liquinox)
- \_\_\_ Disposable Teflon or polyethylene bailers
- \_\_\_ Document control logbook
- \_\_\_ Field forms (i.e., borehole/well constructions form, daily field report forms)
- \_\_\_ Field notebook
- \_\_\_ Fire extinguisher
- \_\_\_ First aid kit
- \_\_\_ Glass jar
- \_\_\_ Grain-size sieves
- \_\_\_ Hard hat
- \_\_\_ Hearing protection
- \_\_\_ Imhoff cone
- \_\_\_ Measuring wheel
- \_\_\_ Munsell soil/rock color chart
- \_\_\_ Nitrile or latex sampling gloves
- \_\_\_ pH paper
- \_\_\_ PID or FID, or gamma/beta meter if required
- \_\_\_ Rock hammer
- \_\_\_ Safety glasses
- \_\_\_ Sample containers/labels
- \_\_\_ Signs listing responsible persons, restricted entry, hearing protection/hard hat/safety glasses/safety shoes required
- \_\_\_ Soil sample tubes
- \_\_\_ Steel measuring tape with engineering scale
- \_\_\_ Steel spatula
- \_\_\_ Stopwatch or watch with second hand
- \_\_\_ String
- \_\_\_ Teflon tape (4 in. wide)
- \_\_\_ Water-level meter
- \_\_\_ Zip-Loc plastic bags